rated in analysis. Natural waters that contain only 3 or 4 parts per million of the two together are likely to carry about equal quantities of sodium and potassium. As the total quantity of these constituents increases the proportion of potassium becomes less; waters carrying from 30 to 50 parts per million of the two may contain from four to ten times as much sodium as potassium; waters carrying more sodium may contain smaller proportions of potassium. Moderate quantities of these constituents have little effect, but waters that carry more than 50 parts per million of the two may require careful operation of steam boilers to prevent foaming. Waters that contain large quantities of sodium salts injure crops and some waters contain so much sodium that they are unfit for nearly all uses.

Carbonate and bicarbonate (CO_3 and HCO_3) occur in waters largely through the action of carbon dioxide, which enables the water to dissolve carbonates of calcium and magnesium. Carbonate is not present in appreciable quantities in many natural waters. The bicarbonate in waters that come from insoluble rocks may amount to less than 10 parts per million; many waters from limestone contain from 200 to 400 parts per million; and certain waters that contain sodium bicarbonate may carry 1,000 or more parts per million of bicarbonate. The bicarbonate as such has comparatively little effect, although a large quantity may make water unsatisfactory for drinking and other domestic uses.

Sulphate (SO_4) is dissolved in large quantities from gypsum and from deposits of sodium sulphate. It is also formed by the oxidation of sulphides of iron and is therefore present in considerable quantities in waters from mines and from many beds of shale. Many alkali waters contain more than 1,000 parts per million of sulphate. Sulphate in waters that contain much calcium and magnesium causes the formation of hard scale in steam boilers and may increase the cost of softening the water.

Chloride (Cl) is dissolved in small quantities from rock materials in most parts of the country. The chloride in waters has little effect on their use unless it is present in excessive quantities, as in brines.

Nitrate (NO_3) in water is considered a final oxidation product of nitrogenous organic material. The quantities usually present have no effect on the value of water for ordinary use.

Hardness is usually expressed as the quantity of calcium carbonate ($CaCO_3$) equivalent to the calcium and magnesium present and is calculated by multiplying the quantities of these elements by 2.5 and 4.1, respectively. Water that has less than 50 parts per million of "hardness," as thus determined is usually rated as soft and its treatment for removal of hardness is rarely justified. Hardness between 50 and 150 parts per million does not seriously interfere with the use of water for most purposes but it does slightly increase the consumption of soap and its removal by softening processes will be profitable for laundries or other industries that use large quantities of soap. Hardness beyond 150 parts per million is noticed by anyone, and in many places where natural waters have hardness of from 200 to 300 parts per million cisterns are used for storing rain water for use in laundry work.